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ABSTRACT

This report is intended as an information resource for teachers, scientists, and others involved in developing science curricula, science literacy materials for the public, or related information addressing issues of science education reform. The following sections are included: (1) Introduction; (2) The Big (Numbers) Picture: Selected Data; (3) Some Positive Signs of Strength; (4) Selected Developmental Issues; (5) Glossary of Selected Terms; (6) Key Acronyms in Science Education: (7) Resources for Science Education: (8) Characteristics of Good Curricula; (9) Model Programs and Projects; (10) Key Contact Directory; and (11) Public Health Service Life Sciences Education and Science Literacy Board Members. Contains a 94-item bibliography. (ZWH)

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STATE of the SCENE

Science and Education in the Nation

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U.S. Department of Health and Human Services
Public Health Service
Agency for Health Care Policy and Research

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Science Education in the Nation

U.S. Department of Health and Human Services
Public Health Service
Agency for Health Care Policy and Research
Rockville, Maryland

AHCPR Pub. No. 94-0007
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Foreword

This updated version of *State of the Scene: Science Education in the Nation*, is intended as an information resource for teachers, scientists, and others involved in developing science curricula, science literacy materials for the public, or related information addressing issues of science education reform. This publication originally was developed in support of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), and the resultant charge to the U.S. Department of Health and Human and Services (DHHS), and the Public Health Service (PHS), to spearhead the science education and literacy effort for the life sciences. It was designed for use as a reference document for participants in a PHS national conference on life science education and science literacy to help in developing a plan to use the scientific assets of the PHS.

It is hoped that the materials presented here will contribute to the expanding national dialogue about how to reform and improve science education, and to meet specific national education goals. As an integral part of the education reform initiative, PHS is focusing on the need to improve levels of biomedical and behavioral sciences literacy within the broad base of the population, while attracting young people to, and retaining their interest in, these disciplines.

This publication is one of many PHS resources being developed, and provided for widespread use, under the auspices of the PHS Life Sciences Education and Science Literacy Board. Eight PHS agencies and the Office of the Assistant Secretary for Health are represented on the current Board. In addition, each PHS agency has identified areas of emphasis, in public science literacy and life sciences education, that are relevant to its mandate. Information on a particular agency's plan can be obtained from the appropriate PHS Life Sciences Education and Science Literacy Board representative listed in this publication.

Acknowledgments

This publication serves to increase understanding of the present scene of science education from a program resource perspective. It provides statistics and defined terms that teachers and scientists can use in science education to expand knowledge for students in K-12, for graduate education, and general public science literacy. Also, the publication provides information on model programs that can generate similar educational efforts across the country.

The materials herein represent a synthesis of the work of many individuals and agencies, although the treatment is not purported to be comprehensive. Thanks go to Allen Schmieder, Ph.D., U.S. Department of Education, who developed the concept, and provided most of the materials included in the original, and this updated, publication. Lynn Kazemekas, Ed.D., Gerri Michael-Dyer, and Sandra Pressman, Agency for Health Care Policy and Research, Public Health Service, provided editorial review and production management, with the assistance of Susan Clabbers, Frances Grimes, Selma Perry, Joann Staton, and Judy Wilcox.

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Introduction

America is facing a significant challenge in science and mathematics education as evidenced by the following:

- Declines in American student performance in science and mathematics relative to international peers.
- Lack of current scientific knowledge among many American teachers.
- Insufficient numbers of students pursuing necessary education and training to fill critical scientific and technical jobs.
- Underrepresentation of women, minorities, and persons with disabilities, in science courses and careers.
- Low levels of scientific literacy among the American public.

In September 1989, the President convened an Education Summit with the Nation's Governors and established six National Education Goals for the United States. These goals were designed to establish targets for educational achievement by the year 2000, and to serve as the framework for the national movement to improve education.

America 2000

1. All children start school ready to learn.
2. At least 90 percent graduate from high school.
3. Students demonstrate competency in challenging subject matter including English, mathematics, science, history, and geography.
4. U.S. students lead the world in mathematics and science achievement.
5. Every adult American is literate, is able to compete in the workplace, and can exercise the rights and responsibilities of citizenship.
6. Every school is free of drugs and violence, and offers a disciplined environment conducive to learning.

Education in America is a partnership effort involving Federal, State, and local governments; educators and parents; business and industry; professional associations; and community-based organizations. However, the Federal Government can play a leadership role by highlighting national problems, mobilizing national support, and funding programs that offer unique national solutions.

In addition to Federal dollars, other Federal resources can be used to support educational improvement, including the Nation's vast network of Federal scientific laboratories, technical facilities, and expert personnel, and the science- and mathematics-related information and materials they produce. These resources, along with volunteer teaching outreach conducted by Federal employees and their contractors, have a previously unrecognized and underutilized potential for rapidly improving the basic science knowledge of American teachers and students.

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The Big (Numbers) Picture: Selected Data

Many feel that it was a set of statistics that started—or at least provided the major early propulsion for—mathematics and science education reform. The most powerful numbers were those that related to the dismal performance of U.S. students compared with the achievement of students in other nations, and those that showed that, despite a dramatic increase in spending on education over the past decade, there had been little or no gain in student achievement.

Following are data highlights and demographics that relate to various aspects of mathematics and science education. The data will be useful for persons who are not familiar with the state of science education. Also, they will provide backup for professional science educators to use as they go about their most important mission: to educate America's population.

There is an increasing amount of reliable information about the U.S. educational system. The selected bibliography included in this publication provides a list of information sources on science education. The U.S. Department of Education, the National Science Foundation, and those parts of other Federal agencies concerned with science education, have stepped up significantly their efforts to develop comprehensive and dependable data bases for education policymakers. No matter what the focus of a particular reform program, there are relevant data that can provide perspective about the general national condition.

- Responsibility for education in the Nation rests with 57 States and Territories.
- There are approximately 15,700 public school systems in the Nation.
- There are an estimated 110,000 public and private schools in the Nation.
- Approximately 46 million students were enrolled in public schools in 1989.
- In 1989, there were 2.7 million teachers and faculty in elementary and secondary schools, and 2.3 million "other" professional, administrative, and support staff.
- Private schools enrolled 5.4 million students, who were served by approximately 300,000 teachers and 200,000 administrative and support staff.
- In 1950, teachers made up 70 percent of staff hired by public schools; in 1988, that figure had declined to 53 percent.
- Of those students in schools, approximately 70 percent are white, 16 percent are African-American, and 10 percent are Latino. The teaching force is approximately 89 percent white, 7 percent African-American, and 4 percent Latino.
- Seventy percent of public school teachers, and 78 percent of private school teachers are women, and 48 and 55 percent, respectively, are younger than age 40.
- Seventy-five percent of public school administrators are men, and 89 percent are white; in private schools, 48 percent are men, 95 percent are white.
- The pupil-teacher ratio has declined steadily since 1970 (22:3), reaching a reported 17:2 in 1989.
- In the 1990s, public school enrollments are projected to grow by 9 percent (from 40 to 44 million); private schools by 8 percent (from 5.2 to 5.7 million). The largest gains will be at the secondary level, where a jump of 16 percent is projected for both public and private schools.
- In the 1990s, the field of teaching will require 200,000 new teachers each year, yet the number of students choosing teaching as a career keeps declining.
- The median-per-pupil expenditure rose from $2,403 in 1970 to approximately $4,500 in 1990 (a 28 percent increase from 1980).
- The national average for sources of revenue for public elementary and secondary schools is: Federal, 6 percent; State, 50 percent; local, 44 percent. The State-local ratio varies dramatically across the Nation and, in recent years, the State share generally has been increasing.
- In 1985 to 1986, there were an estimated 302,000 science and mathematics teachers for grades 7 to 12 (in public and private schools);

135,000 taught science and mathematics in grades 7 to 9, 80,000 in grades 10 to 12, and 87,000 in both grades 7 to 9 and 10 to 12.

- The average size of science and mathematics classes is approximately 23 students.
- The average number of science and mathematics courses completed by high school graduates increased substantially between 1982 and 1987; the mean number of science courses rose from 2.2 to 2.6, and mathematics courses from 2.5 to 3.0.
- The President's fiscal year 1992 budget proposed to invest $1.94 billion in mathematics and science education programs. This represented an increase of $225 million, or 13 percent, over the fiscal year 1991 funding level for these programs.

Precollege:	$660 million
Increase over FY 1991:	$146 million (+28 percent)
Undergraduate:	$477 million
Increase over FY 1991:	$60 million (+14 percent)
Graduate:	$803 million
Increase over FY 1991:	$19 million (+2 percent)

- In 1990, African-Americans comprised 12 percent of the Nation's population, 2 percent of its scientists and engineers. Latinos comprised 9 percent of the Nation's population, 2 percent of its scientists and engineers. Asian Americans comprised 2 percent of the Nation's population, 4 percent of its scientists and engineers. Native Americans comprised 0.6 percent of the Nation's population, 0.5 percent of its scientists and engineers. Women comprised 51 percent of the Nation's population, 11 percent of its scientists and engineers. Americans with disabilities comprised 9 percent of the Nation's population, 0.0004 percent of its scientists and engineers.
- By the time children are in the seventh grade, half declare no interest in science. At the other end of the science pipeline, only six of every 4,000 seventh graders (five males and one female) ultimately will receive Ph.D. degrees in science or engineering.
- Currently, only 8 percent of bachelor's degrees in science and engineering are awarded to African-Americans and Latinos (20.2 percent of the total population combined); together, these minorities earn only 4 percent of all science and engineering doctoral degrees.
- In a recent international science achievement survey that compared students in the U.S. and 15 other nations, U.S. high school seniors scored among the lowest fourth on calculus and algebra achievement tests. Among seniors studying "advanced placement" biology, Americans placed last out of 13 nations.
- According to teacher self-assessments in 1985, 82 percent of grade K-6 teachers felt well qualified to teach reading, 67 percent to teach mathematics, only 27 percent to teach life sciences, and only 15 percent to teach either physical, or earth and space, science.
- Performance variations among students from different geographic areas are substantial. Rural and urban elementary science classes are almost twice as likely as suburban science classes to take place in classrooms with no science facilities.
- Although Americans have universal access to education and broad access to information, the state of American public scientific literacy is distressing. In one recent study, half the adults questioned did not know that it took one year for the Earth to orbit the Sun.

Some Positive Signs of Strength

- The President and Governors are working together as never before to reform and improve American education generally, and science and mathematics education specifically.
- The mathematics and science educational communities are working together in unprecedented ways to develop reformed and improved curricula, and related evaluation and teacher training programs.
- Despite concerns that the United States is losing its competitive edge in science and engineering, the Nation still is acknowledged as a world leader in such critical enterprises as agriculture, medicine, aerospace, computer and related technologies, cosmology, oceanography, and military technology. Our research and development effort in science remains the largest and strongest in the world.
- The American public believes in the benefits of science and technology, and polls consistently show that Americans are willing to invest more money in education if a good case can be made for increased support.
- American graduate education remains the best in the world, with large numbers of foreign students coming here to study.
- Our teachers are among the best educated in the world: 51 percent have a masters or specialist degree, and one percent have doctoral degrees. A significant percentage of those without a graduate degree have an equivalent number of graduate credits, gained through approved merit programs.
- The Nation has recognized that women, minorities, and persons with disabilities must be brought into science and engineering in much larger numbers, and a high priority is given to these groups in most new science education initiatives.
- Both course requirements and enrollments in science education in the Nation's schools have increased significantly over the past ten years. The enrollment of African-Americans and Latinos has increased in most science courses.
- In 1950, only 53 percent of 25 to 29 year-olds had completed high school, whereas in 1988, the figure had climbed to 86 percent. The increase was even more dramatic for minority youth, jumping from 24 percent in 1950 to 82 percent in 1988. In 1950, only eight percent of students completed four years of college; by 1988, the rate had increased to 23 percent.
- In 1990, 90 percent of all high school seniors rated the value of education first among a list of 10 major social issues that included environmental concerns, politics, and money.
- The number of schools and students having access to the Nation's cutting-edge researchers and research facilities in science (including super computers), is increasing each year.
- A recent study by the National Center for Education Statistics revealed that a remarkably high percentage of younger American students use computers in school: kindergarten, 20 percent; grades 1 to 8, 54 percent.
- Since 1980, the number of Americans employed in science and engineering has risen twice as fast as employment in general.

Selected Developmental Issues

Although various individuals, groups, organizations, or agencies currently involved in the reform of science education may compose lists of developmental issues that may be longer, shorter, or somewhat different from that presented below, there would be substantial overlap. The following essentially were drawn from a synthesizing of the major problems and issues that were included in the national studies and reports that are listed in the selected bibliography of this publication.

It was not possible to examine closely all of the leading publications on mathematics and science education produced during the past several years, but a significant percentage of them were studied in composing this set of issues. Since the main objectives of the list are: to orient those who are new to science education reform; and to stimulate rich discussions among those now engaged in strengthening science and mathematics education, a range of issues is presented.

- *There is no national consensus on need.* There is a lack of a national consensus in support of relevant, coherent science education at all levels.
- *The Nation's electorate has a low level of science literacy.* The American public in general is illiterate in the sciences (estimates run as high as 94 percent).
- *Women, minorities, and persons with disabilities, are underrepresented.* The underrepresentation in science, mathematics, and engineering, of women, minorities, and persons with disabilities, has implications for science education policy formulation at all levels. Unless science, mathematics, and engineering programs are developed to attract and retain more women, minorities, and persons with disabilities (an estimated 85 percent will have to come from these groups), the Nation will not be able to meet its technical personnel needs into the next century. The need for more attention to the cultural diversity of the Nation becomes even more urgent as that diversity increases. In 1990, 33 percent of the Nation's school population were minorities; in the year 2000, it will be 40 percent.
- *Student performance is poor.* There has been a decline in performance in mathematics and science by American students relative to their international peers. In recent international competitions in mathematics and science, American students at the fifth, ninth, and 12th grade levels performed poorly in comparison with those of other industrialized nations and even some Third World countries.
- *There are insufficient college enrollments.* There are insufficient numbers of students pursuing careers in science and mathematics teaching. Generally, there are insufficient numbers of students pursuing most careers in science and technology—both at the undergraduate and graduate levels.
- *There is poor college preparation of teachers.* The college preparation of mathematics and science teachers generally is inadequate and not well related to the unique demands of teaching in the schools (especially in urban and rural areas) and to the new technologies. There is a dearth of information about what makes science teacher education programs effective.
- *Many teachers are mathematics and science "avoiders," or are teaching out of certification.* Teachers at all levels of schooling generally are inadequately prepared to teach science and mathematics. The problem is most serious at the elementary school level, where the majority of teachers themselves are mathematics and science "avoiders." At the secondary level, many teachers are teaching out of general certification (e.g., an English teacher is teaching biology) or out of science certification (e.g., a biology teacher is teaching physics). Even those prepared to teach science often are in need of extensive retraining to bring them up to date.
- *Teaching conditions are poor.* The environmental conditions (facilities, equipment, and materials) for teaching science and mathematics generally are outdated and inadequate at the secondary school level, and nonexistent at the elementary school level.
- *Inservice education generally is inadequate.* Although a recent national survey of the Eisenhower Mathematics and Science Education Program indicated that inservice education was the most urgent need of mathematics and science

teachers, such education generally is sporadic, very short-term, and often not related to the most urgent needs of the teachers.

- *Exposure to science in elementary education remains far too low.* Substantial exposure to science usually does not begin early enough in the schools, and what is offered is generally of poor quality. Recent studies indicate that the majority of students become mathematics and science avoiders before they leave elementary school, and a recent nationwide needs assessment, conducted for the Eisenhower Mathematics and Science Education Program, indicated that approximately two-thirds of the States, and two-thirds of the local educational agencies, rated improvement in mathematics and science education as their most urgent need. Yet the overwhelming majority of reform and improvement programs in mathematics and science still are directed at secondary education. At this level, there is also a critical shortage of science education materials and equipment, especially in schools with the greatest need, i.e., those located in inner cities and rural areas.
- *Serious teacher shortages are ahead.* Serious shortages of science and mathematics teachers already are beginning to occur in certain cities and regions of the Nation. These shortages will become severe as more and more teachers in mathematics and science leave teaching for the private sector, retirements accelerate in the 1990s, and increasing school enrollments (especially in high school) and increasing course requirements (at all levels) will require increased numbers of teachers in mathematics and science.
- *State and local roles in educational reform need strengthening.* Although State and local governments have the responsibility for education (and educational quality) in the United States, many reform programs and plans do not place a major emphasis at those levels. With the increasing participation of the Governors in educational reform, this problem could diminish.
- *Integration of the new technologies generally is slow and insufficient.* Although mathematics and science lend themselves well to the use of new technologies, and effective use of new technologies is an increasingly critical skill in the workplace, most mathematics and science instruction in the Nation still is not based on new technologies in computing, television, and so on. Further, the programs that best use new technologies in mathematics and science education are not generally in those schools and school systems for which the need for new recruits in mathematics and science is most urgent.
- *There is need for a cohesive approach in research and development.* U.S. investment in research and development in mathematics and science (as well as in science and technology generally) historically has been the highest in the world. However, research studies are fragmented, and there is no systematic plan for developing a comprehensive knowledge base about mathematics and science education. Although there are some excellent ongoing research studies, generally they focus on a particular problem or element within science education.
- *The school curriculum still is based on textbooks.* Even with the rapidly increasing potential of the new technologies in instruction, and the accelerating rate of change in knowledge that requires that curriculum and teaching approaches continuously be changed, the majority of American classrooms are textbook-focused. In most classrooms in America, the textbook still defines the curriculum. To make matters worse, with an increasing number of States requiring State adoptions of textbooks, experts have concluded that the quality of textbooks is declining, because publishers appeal to the lowest common denominator.
- *Standardized tests are the primary means of measuring success.* Standardized tests are criticized because they do not take into account the cultural and geographic differences across the Nation. In addition, the importance given to these tests results in other adverse outcomes. For instance, much of the curriculum is driven by the content (or estimated content) of standardized tests, which do not measure fairly the success either of individuals or of programs. There is also the issue of a system that advocates the importance of self concept and success for all on the one hand, and on the other, measures success on the basis of test scores.
- *International image and competition are the driving forces behind the need for improved mathematics and science education.* Almost 100 percent of the rhetoric driving the need for improved mathematics and science argues that we must do better if we are to remain competitive internationally. Reform efforts would

be more encompassing, and possibly more successful, if they were based on the assumption that *all students and all Americans* would benefit from knowing more about science and mathematics. Their lives would be richer, they would make better political decisions, and the pool from which to draw science specialists would be enlarged dramatically.

- *The gap between education and work remains great.* Despite efforts during the past decade to develop partnerships between education and business and industry, and to narrow the gap between education and the world of work, there is still a substantial isolation between what happens in schools and the most urgent needs of business and industry. New kinds of partnerships are needed, in which whole communities, including business and industry, work continuously and systematically with schools to raise the quality of life and education in those communities.

- *The assessment and evaluation of science education does not have a high priority.* There are few systems available for assessing and evaluating existing science curricula. One of the outcomes is that many science programs are being reformed without any comprehensive and articulate information about what the "old" programs, or their shortcomings, are. There is a need for more "independent" assessment and evaluation of programs and practices in mathematics and science education.

Glossary of Selected Terms

Alternative Certification
Alternate routes (to the traditional route of an undergraduate degree in education, including student teaching) for individuals to become certified teachers and principals.

America 2000: An Education Strategy
An action plan to move America toward the six National Education Goals by assuring accountability in today's schools, unleashing America's genius to jump-start a new generation of American schools, transforming a "nation at risk" into a "nation of students," and nurturing the values essential to personal responsibility, strong schools, and sound education for all children.

American Achievement Tests
A voluntary, nationwide examination system, based on the five core subjects (including mathematics and science) at the fourth, eighth, and 12th grades, tied to the New World Standards.

Career Ladder
A system of teaching level and pay differentiation, somewhat akin to that used in higher education (instructor, assistant professor, and so on), proposed by educational reformers and used in some cities and States to encourage teaching excellence and increased professional development. Each higher level carries greater authority and responsibility.

Catalog of Federal Domestic Assistance (CFDA)
Published by the U.S. Office of Management and Budget (OMB) and updated with looseleaf additions, this Catalog describes all Federal programs that distribute funds to States, the private sector, nonprofit and profit-making organizations, and individuals. The *CFDA* is available in most major libraries, or by subscription from the Superintendent of Documents, Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15205-7954; telephone (202) 783-3238.

Commerce Business Daily
A publication issued every weekday by the U.S. Department of Commerce, listing all Federal Procurement Invitations. This publication is available in most major libraries, or by subscription from the Superintendent of Documents, Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15205-7954; telephone (202) 783-3238.

Educational Research Information Clearinghouse (ERIC)
A system of national educational information centers on topics of high national importance, administered by the U.S. Department of Education. All centers can be accessed directly, or through local libraries. A center on mathematics, science, and environmental education is located at The Ohio State University, and a center on educational technology is located at Syracuse University.

Eisenhower Mathematics and Science Education State Grants
Administered by the U.S. Department of Education to provide assistance to State and local educational agencies, and institutions of higher education, to improve the teaching and instruction in mathematics and science, and increase access to that instruction. Most funds are channelled to school districts on a formula basis; the remainder is used by States for discretionary projects.

Eisenhower National Mathematics and Science Education Program
Administered by the U.S. Department of Education to support innovative mathematics and science projects of national significance. Provides support for development, demonstration, and technical assistance projects, and helps expand the effect of national reform efforts in mathematics and science. Emphasizes whole-school reform in mathematics and science, and uses funds to leverage Federal, State, and local funding, when possible.

Federal Coordinating Council for Science, Engineering, and Technology (FCCSET)
A Council set up by the Assistant to the President for Science and Technology, Office of Science and Technology Policy in the White House, to pursue ways to coordinate more effectively Federal programs and initiatives in science, engineering, and technology.

Federal Register
A publication issued every weekday by the National Archives and Records Administration listing all Federal agency regulations and legal notices, including details of all Federal grant competitions. This publication is available in most major libraries, and by subscription from the Superintendent of

Documents, Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15205-7954; telephone (202) 783-3238.

Federal Role In Education

Education in America is a partnership effort involving Federal, State, and local governments; educators and parents; business and industry; professional associations; and community-based organizations. The Federal Government, as a user and patron of a large segment of the Nation's scientific and technical workforce, has a direct stake in the quality of mathematics and science education. Although only approximately six percent of the total spending for elementary and secondary education comes from Federal sources, the Federal Government can play a leadership role by ensuring equal educational opportunity, highlighting national problems, mobilizing national support, providing support for research and development in critical areas, supporting assessment of, and providing the Nation with, information on the status of education, and funding programs that offer unique national solutions.

Governors' Academies for School Leaders

State or regional academies launched with Federal seed money that train principals and other school leaders in the design and execution of school improvement strategies, accountability mechanisms, and school-site management.

Governors' Academies for Teachers

Academies, established in every State with Federal seed money, for teachers of the five core subjects (including mathematics and science) to ensure that they possess the knowledge and skills they need to help students attain the New World Standards and pass the American Achievement Tests.

Merit Pay

A system proposed by some educational reformers, and experimented with in some school systems, in which special pay is given to teachers who either teach subjects for which there are teacher shortages (e.g., mathematics and science), teach in unusual places or circumstances, or who achieve high levels of performance.

National Assessment of Educational Progress

A periodic national assessment of student achievement, especially targeted at the fourth, eighth, and 12th grades, financed by the U.S. Department of Education and developed and conducted by the Educational Testing Service. The purpose of the assessment is to provide the Nation and education policymakers with both a current and historical measure of the relative success of students and schools in certain core subjects.

National Center for Education Statistics

A Center within the U.S. Department of Education that is charged with collecting, analyzing, and disseminating current information about the Nation's educational system. The Center produces a large number of reports on the nature and health of American education, including annual reports on *The Condition of Education* (separate volumes on elementary and secondary, and postsecondary education), *Youth Indicators*, and *Digest of Education Statistics*. Examples of recent special topic reports are *The American Eighth Grader*, and *Federal Support for Education: Fiscal Years 1980 to 1989*.

National Diffusion Network

The National Diffusion Network (NDN) is a Federally-funded system administered by the U.S. Department of Education that makes exemplary (validated) educational programs available for adoption by schools, colleges, and other institutions.

National Education Goals

Following the 1989 Education Summit, the President and Governors established six national goals for improving education in the United States.

National Educational Research and Development Centers

Twenty-five university-based centers, supported by the Office of Educational Research in the U.S. Department of Education, that are directed at strengthening student learning in the Nation. The centers conduct research on topics that will help policymakers, practitioners, and parents meet the National Education Goals. In addition to addressing specific topics, all of the centers also give some attention to children at risk. The centers include a center on science at The Ohio State University, a center on mathematics at the University of Wisconsin, and a center on technology at Bank Street College, New York City.

National Science Foundation

Initiates and supports education programs in virtually all fields of science and engineering, at all

education levels. Comprises almost one-quarter of the total Federal education effort in mathematics and science. Its precollege programs, in both the formal and informal arenas, lead other agencies in the support of curriculum development and organization reform; its teacher preparation and enhancement programs are second in scope only to those of the U.S. Department of Education.

National Science Resources Center

Jointly sponsored by the Smithsonian Institution and the National Academy of Sciences to improve the teaching of science and mathematics in the Nation's schools. Disseminates information about effective science and mathematics teaching resources, develops "hands-on" curriculum materials, and sponsors outreach and leadership development activities. The first priority of the Center is improving science teaching in elementary schools. It offers a comprehensive resource collection and computer information data base of elementary science curriculum materials, and an annotated elements of science resource guide. A network of 6,000 scientists and science educators has been created to work with the Center on improving the teaching of science in elementary schools.

National Science Scholars Program

Authorized by the Excellence Act of 1990, which was signed into law on November 16, 1990, and administered by the U.S. Department of Education. This program is specifically designed to provide student incentives, and currently provides scholarships of up to $5,000 to graduating high school students who have excelled in science, mathematics, and engineering.

New World Standards

Standards being developed in conjunction with the National Education Goals Panel. These New World Standards (for each of the five core subjects, including mathematics and science) will represent what young Americans need to know, and need to be able to do, if they are to live and work successfully in today's world.

Regional Educational Laboratories

Educational laboratories set up in each of the U.S. Department of Education's ten regional areas to help educators and policymakers solve pressing education problems in their schools. Using the best available information, and the experience and expertise of professionals, the laboratories identify solutions to education problems, try new approaches, furnish research results and publications, and provide training to teachers and administrators.

School Choice

A process in a local or State educational system in which parents and students can choose the school to attend. Generally, their decisions would be based on quality factors rather than on geographic location. In most pilot choice programs, parents and students can choose among both public and private schools.

Science Education Partnership Award

A grant program initiated in fiscal year 1991 by the Alcohol, Drug Abuse, and Mental Health Administration, and the National Institutes of Health, to encourage development of model projects on health-related science that contribute to science education at the K-12 levels and the general scientific literacy of the public. Projects for school children should convey the scientific process in a way that engenders enthusiasm for science. Projects for the general population should help increase knowledge of scientific terms, concepts, and reasoning, and ability to understand scientific public policy issues. Priority is being given to projects that are innovative, have potential for replication and widespread use, and build on existing science education programs.

Targeted Federal Program in Mathematics and Science Education

A Federal program in mathematics and science education that is directed totally at improving and reforming mathematics and science education, e.g., the Eisenhower National Mathematics and Science Education Program.

Key Acronyms in Science Education

The following is a list of acronyms that relate to mathematics and science education reform, with a special emphasis on Federal programs and activities, and major life science initiatives.

AAAS	American Association for the Advancement of Science
AACTE	American Association of Colleges of Teacher Education
AAG	Association of American Geographers
AAPT	American Association of Physics Teachers
AASA	American Association of School Administrators
ACS	American Chemical Society
AFT	American Federation of Teachers
AHCPR	Agency for Health Care Policy and Research
AHEC	Area Health Education Center
AIBS	American Institute of Biological Sciences
AISES	American Indian Science and Engineering Society
APA	American Psychological Association
ASCD	Association of Supervision and Curriculum Development
ASSM	Association of State Supervisors of Mathematics
ASTC	Association of Science-Technology Centers
ATE	Association of Teacher Educators
BIA	Bureau of Indian Affairs
BSCS	Biological Sciences Curriculum Study
CCSSO	Council of Chief State School Officers
CDC	Centers for Disease Control
CEHR	Committee on Education and Human Resources
DASH	Developmental Approaches in Science and Health
DHHS	U.S. Department of Health and Human Services
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
ECS	Education Commission of the States
ED	U.S. Department of Education
EPA	Environmental Protection Agency
ERIC	Educational Research Information Clearinghouse
ESEA	Elementary and Secondary Education Act
ETS	Educational Testing Service
FAES	Foundation for the Advancement of Education in the Sciences
FCCSET	Federal Coordinating Council for Science, Engineering, and Technology
FDA	Food and Drug Administration
FIPE	Fund for the Improvement of Postsecondary Education
FIRST	Fund for the Improvement and Reform of Schools and Teaching
GEMS	Great Explorations in Mathematics and Science
HCFA	Health Care Financing Administration
HRSA	Health Resources and Services Administration
IHS	Indian Health Service
JETS	Junior Engineering Technical Society

LEA	Local Educational Agency
MAPS	Math Achievement through Problem Solving
MARC	Minority Access to Research Careers
MESA	Mathematics, Engineering, Science Achievement, Inc.
MHSSRA	Minority High School Student Research Apprentice Program
MSEB	Mathematical Sciences Education Board
MSIP	Minority Science Improvement Program
NABT	National Association of Biology Teachers
NACME	National Action Council for Minorities in Engineering
NAEP	National Assessment of Educational Progress
NAIS	National Association of Independent Schools
NARST	National Association of Research on Science Teaching
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NASBE	National Association of State Boards of Education
NCATE	National Council for Accreditation of Teacher Education
NCES	National Center for Education Statistics
NCET	National Center for Educational Technology
NCGE	National Council for Geographic Education
NCTM	National Council of Teachers of Mathematics
NDN	National Diffusion Network
NEA	National Education Association
NGA	National Governors Association
NIH	National Institutes of Health
NRC	National Research Council
NSB	National Sciences Board
NSBA	National School Boards Association
NSF	National Science Foundation
NSRC	National Science Resources Center
NSSA	National Science Supervisors Association
NSTA	National Science Teachers Association
OTA	Office of Technology Assessment (U.S. Congress)
PALs	Public Academic Linkages
PHS	Public Health Service
SAHE	State Agency for Higher Education
SAMHSA	Substance Abuse and Mental Health Services Administration
SEA	State Education Agency
SECME	Southeastern Consortium for Minorities in Engineering
SEPA	Science Education Partnership Award
SHARP	School Health Additional Referral Program
SHARP	Summer High School Apprenticeship Program
SSC	Scope, Sequence, and Coordination (Project)
SSSA	State Science Supervisors Association
UMC	Urban Mathematics Collaboratives

Resources for Science Education

Funding support, and potential support, for educational change is higher than ever. Private philanthropy now provides more than $100 billion per year, and the value of volunteered time (a major new thrust in science education reform in the United States) now also has reached this amount. A recent study by the U.S. Department of Education showed the annual Federal investment in education to be almost $60 billion per year—with more than half of that total being spent by agencies other than the U.S. Department of Education and the National Science Foundation.

This remarkable fact probably reflects the growing importance of education in American society and the increasing connection between education and business and industry. It may be also one of the strongest pieces of evidence that one could give regarding the close connection that is being drawn between the quality of American education and the quality of the Nation's competitiveness in the world arena. There is a double message to program reformers in science education: (1) almost every Federal agency is involved in educational reform in one way or another and is a potential source of information or funding; and (2) real reform must be based on a broad perspective, including goals that relate to the missions of many government agencies at the national, State, and local levels.

Many Federal agencies have programs in science education. Those programs are described in the publication, *By the Year 2000: First in the World*, which was published in February 1991 by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) Committee on Education and Human Resources. This report provides information on the many Federal programs that are intended to improve the teaching and learning of science in the United States.

The FCCSET Committee did an excellent job of summarizing the programs and expenditures of the Federal agencies currently most involved in supporting mathematics and science education. It should be pointed out, however, that this effort was the first in history to identify and articulate effectively mathematics and science education programs across all Federal agencies. It was a pioneering effort at laying the foundation for more effective coordination and cooperation across the Government and the Nation.

It was a very challenging task to determine how best to define and estimate program activities directed at mathematics and science education. Some programs are directed totally at those subjects, others have general goals that include mathematics and science, and still others are not directed at mathematics and science, but have discrete mathematics and science elements. Some programs support the improvement of formal education, others of informal education. Some agencies and programs collect discrete data relating to particular emphases within programs, others do not.

Suffice it to say that this pioneering effort was courageous and monumental, but it must be taken as a first edition of what should become an increasingly accurate annual summary of the state of Federal support of mathematics and science education.

Characteristics of Good Curricula

During the past five years, an enormous amount of professional work has gone into detailing what American young people should know and be able to do in order to be educated, productive, and healthy adults. All the national content area reports—in English, science, mathematics, reading, social studies, art, foreign languages, history, and the rest—abound in powerful, practical ideas about what American students should learn and how they should learn it.

Almost all of the reports, in various ways and using various terms, call for:

- Higher expectations and standards for all students, not just those who are college-bound; more challenging and interesting content for everyone, based on the assumption that all students can learn whatever they are motivated to learn when they are given adequate opportunities to learn.
- More responsiveness to the diverse needs of an increasingly diverse student body.
- More active learning for students and less passivity; more hands-on, direct opportunities to "make meaning" with language, science, mathematics, writing, and so on; fewer remote, irrelevant, or concocted educational experiences; more primary sources, original documents, and "real life" contexts.
- More small-group learning for students, and less isolated learning; more time spent working together democratically, as people do in real work and civic situations, and less time spent in competitive learning environments.

The following general recommendations are derived from a report on the First National Curriculum Congress, 1990:

- More authentic performance assessment of students and educators, and less emphasis on standardized testing; more accountability for strong learning experiences, and much less for test scores.
- More critical and creative thinking and problem solving for students, and less emphasis on rote knowledge, drill, and memorization.
- More learning for understanding, and less learning for grades or scores; more education about how to learn throughout life.
- More organization of time around student learning, and less organization of time around adult or bureaucratic needs.
- More diverse kinds of teaching and learning opportunities in order to accomplish the above goals.

It should be stressed that these common themes emerge in each case from concerns that students be grounded solidly in the facts, essential knowledge, and modes of operation central to each discipline. Fundamental knowledge has not been displaced by concern with processes; rather, new and more powerful processes of learning and teaching have come to be seen as critical if all students are to master more challenging curricula.

Model Programs and Projects

Following are brief descriptions of national educational reform efforts in science and mathematics, as well as selected projects that represent exemplary curricula and innovative approaches to teaching science and mathematics, and involving teachers, students, parents, and the community, in the excitement of science and its relevance to today's world.

Project 2061
American Association for the Advancement of Science

This project has a three-phase plan for purposeful and sustained action to contribute to the reform of education in science; mathematics, and technology. Phase I, essentially completed, focused on the substance of scientific literacy by identifying the knowledge, skills, and attitudes all students should acquire from their school experience from kindergarten through high school. This phase resulted in an overview report, *Science for All Americans*, published in 1989.

Phase II involves teams of educators and scientists developing alternative curriculum models for use in school districts and States. This component also includes drawing up blueprints for reform related to the education of teachers, materials and technologies for teaching, testing, the organization of schooling, educational policies, and educational research.

Phase III will be a widespread collaborative effort, lasting at least a decade, in which many groups active in educational reform will use their resources to move the Nation toward scientific literacy.

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Curriculum and Evaluation Standards for School Mathematics
National Council of Teachers of Mathematics

Launched in 1989 to reform the learning situation in mathematics, the *Standards* were written to respond to five important needs: (1) a knowledge of mathematics that lasts and develops; (2) an informed electorate; (3) mathematically literate workers; (4) opportunity for all students; and (5) problem-solving skills that serve lifelong learning. The Council created a list of 40 curriculum standards divided into three grade-level groups: K-4, 5-8, and 9-12. The *Standards* specify elements of good mathematics programs, such as problem solving, communicating, reasoning, and approaching the field as a unified whole while learning specific concepts and procedures. However, they neither list grade-level topics nor suggest hierarchies, and thus allow accommodations to individual needs.

Assessment standards were also developed to guide teachers and administrators in evaluating curricula, improving instruction, testing students, and assessing the program. Standards for teaching mathematics also are being developed. The Council plans and supports materials and conferences for professional development; creates videotapes, books, and other materials; supports school-based research projects; and studies and assesses the use of calculators in mathematics classes.

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Mathematical Sciences Education Board
National Research Council

The Board was established in 1985 to provide a continuing national overview and assessment capability for mathematics education. There was concern for the quality of this education, because mathematics is the foundation for science, engineering, and the U.S. technical enterprise, and increasingly, education in mathematics is a significant factor in determining the strength of the Nation's work force and the opportunities open to individuals.

Support is provided for six major activities: (1) leadership of continuing efforts to improve mathematical sciences education nationally; (2) coordination among existing mathematics education projects; (3) service to localities and States through assistance in determining curricular goals, higher standards for all students, and improving teacher preparation; (4) recommendations of ways to strengthen weak parts of the infrastructure of mathematics education; (5) information to increase public understanding of the rapidly changing missions and character of the

mathematical sciences; and (6) advice to Federal, State, and local agencies on long-range goals and needs in mathematical sciences education. Major focus areas are curriculum and instruction, student assessment, the teaching profession, outreach and impact, and minorities issues. The Board constitutes a unique coalition of mathematics teachers and supervisors, college and university mathematicians, educational administrators, parents, and representatives of government and business.

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Scope, Sequence, and Coordination of Secondary School Science

National Science Teachers Association

This project undertakes a major reform of science education at the secondary level. Its fundamental goal is to make each of the basic sciences understandable and enjoyable for all students. It represents a radical departure from the normal pattern of secondary science instruction, the traditional "layer cake" curriculum of discrete disciplines. Rather, it advocates carefully sequenced, well coordinated instruction in all the sciences, with students studying science every year for six years. Learning is developed through direct hands-on experiences first, and terminology, symbols, and equations later. Fewer topics are taught, spaced over several years, to provide greater depth of understanding. The concepts of science are built on repeated experiences in different contexts, with science applied to personal and societal problems. The project also emphasizes the interdependence of the sciences, and how they fit together as part of a larger body of knowledge.

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Interactive Video Disk Assessment of Student Performance in Scope, Sequence, and Coordination Reform Programs

National Science Teachers Association

The National Science Teachers Association is developing, disseminating, and evaluating student assessments, based on performance, through the technology of interactive optical disks. The assessments are being developed in cooperation with the Educational Testing Service and American Interactive Media, and will be administered to students in test site schools that are implementing the project on Scope, Sequence, and Coordination of Secondary School Science. These include students in selected schools in the Houston Independent School District and in the State of California. Several additional trial sites will implement the reform program, and become recipients of the computer-based assessments. Assessment results compared with test samples of control student populations (those advancing through the traditional "layer cake" science curriculum) will indicate relative success or failure of the reform effort. The prototype interactive video disk assessment will measure student performance in seventh grade earth and space science, biology, chemistry, and physics. The assessment then will be field-tested. The seventh grade prototype will form the basis for future test development in successive grade levels.

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Science and Technology for Children Project

National Academy of Sciences

The National Science Resources Center at the Smithsonian Institution, Washington, DC, has initiated this unique elementary science materials project to develop a set of activity-centered science units for grades 1-6 that are focused on important topics in life science, physical science, earth science, and technology. Study units are designed to make use of kits of inexpensive apparatuses that school systems themselves can assemble and maintain, and to make science teaching more manageable for

elementary school teachers by linking instruction in science with other subjects in the elementary school curriculum, such as reading, writing, and mathematics. Study units provide opportunities for children to work directly with electrical circuits, pendulums, chemical substances, microscopes, rocks and minerals, plants, and other organisms. These hands-on experiences will help children to learn not only scientific concepts, but also mathematical problem-solving, and higher-order thinking skills.

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Science for Life and Living: Integrating Science, Technology, and Health

Biological Sciences Curriculum Study

This comprehensive K-6 curriculum focuses on science as a way of knowing, technology as a way of doing, and health as a way of behaving. This program incorporates a contemporary instructional model, engaging hands-on activities, cooperative learning, and a strong emphasis on oral and written communications. The curriculum encourages children and teachers to use a variety of methods as they construct their own understanding of the world. The program concentrates on a few major concepts and skills that are common to the three disciplines of science, technology, and health. By focusing on depth rather than breadth of knowledge, the students are allowed the time and opportunities they need to develop a richer and more meaningful interpretation of the world.

The project will produce a teacher's edition and student's text for each grade level, an implementation guide, and supplemental materials designed to help busy teachers incorporate science studies into the other basic subjects of reading, writing, and mathematics. The complete program will be available from Kendall/Hunt Publishing Company. Science Kit, Inc., will supply the hands-on materials for each grade level of the program.

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Super Science: A Mass Media Program

Scholastic, Inc.

This project has launched two classroom science magazines, one for grades 1-3, another for grades 4-6, with a companion series of computer-disk materials. It stresses hands-on and inquiry activities that mix science with reading, mathematics, and social studies. The science and technology skills and know-how that students will need as consumers, workers, and citizens, are important to the development of the project. The magazines have teachers' guides and a special periodical for early grade teachers. The project's staff used a three-part, team-support effort to develop *Super Science*. A panel of leaders in science education served as advisors and consultants.

Administrators and teachers in nine ethnically diverse districts nationwide helped formulate the scope and sequence plan for the magazines and software, and tested materials for class practicality. The Triangle Coalition for Science and Technology Education is providing funding during the four-year development phase, and will continue the activities in subsequent years.

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The Life Lab Science Program

Life Lab Science Program, Inc.

This is a broad expansion of a program that has had ten years of successful piloting and tryouts throughout the country, particularly in California. The instructional approach for this K-6 program is a combination of indoor and outdoor hands-on science activities, with the key component being the garden lab (e.g., indoor grow box, greenhouse, planter boxes, and vegetable beds). Students and teachers collaborate to transform their school grounds and classrooms into thriving garden laboratories for the study of scientific processes. In this setting, students conduct experiments using the scientific method. They observe, collect, and analyze data, establish worm colonies, raise vegetables, herbs, and flowers, and have responsibility for maintaining their living laboratory. The program integrates conceptual learning and practical applications. The applications demonstrate to the students how science relates to their everyday lives. They learn, for example, how their bodies, like plants, need nutrients, which are

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available from various sources. A variety of learning is derived from this work, relating to ecology, ethical issues, decisionmaking, and so on.

The materials for hands-on work are not only familiar to most teachers, but in terms of their quantities and cost, are both affordable and manageable. Addison-Wesley Publishing company is providing staff and financial support from development through dissemination and teacher training.

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Developmental Approaches in Science and Health

Curriculum Research and Development Group, University of Hawaii

This program for elementary education introduces science sequentially, and integrates it with other school subject areas. It is designed to narrow the gap between the way science is taught and the way science is used in a demanding technological society.

Science, health, and technology are presented through a developmental approach that enables students to use their prior knowledge and immediate experiences to grasp basic concepts and to see how these form a foundation on which to build ideas of increasing complexity and learning independence.

The hands-on activities provided are teacher-friendly, require a minimum of preparation, and are flexible enough to deal with the realities of the classroom. School studies are connected to the world of daily living, commerce, communication, transportation, medicine, and research. Science, health, and technology are linked with mathematics, language, social studies, music, and art, to help students understand the integration of the human experience.

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Intensive Science Methods and Content Training Program

Carnegie Mellon University

This project provides teacher training in science instruction methods and content for 280 public and private elementary school teachers in the Monongahela Valley near Pittsburgh. Elementary school teachers are being trained to implement the science curriculum package, Developmental Approaches in Science and Health (DASH). The project provides intensive, ongoing, hands-on education of teachers, and selection of highly qualified and prepared teachers to train other teachers in DASH methods.

The plan of operation features five essential components: promoting awareness; teacher training; follow-up coaching and evaluation; trainer and coordinator training; and producing supplemental materials. The Carnegie Mellon DASH dissemination group is the largest and most diverse in the Nation and serves an urban, industrialized area. The entire Nation will benefit from this group's experience in system-wide implementation. In addition, the Carnegie Mellon group is producing supplemental materials to the DASH curriculum that will be transferable to any location in the United States, including an administrator's handbook, and take-home newsletters designed to improve family participation in the education of the child.

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Conservation for Children

John Muir Elementary School

This program teaches children in grades 1-6 about the interdependence of plants and animals, requirements of life, energy sources and use, pollution problems, recycling, and other conservation concepts based on scientific principles. The grade level conservation guides provide instructional materials that combine basic skill practice in the areas of languages, arts, mathematics, social studies, and sciences, with a conservation concept.

Teachers can use the materials as a primary resource for teaching basic skills, as supplementary materials to a core program, as enrichment activities, for skill review, or as independent units of study.

Criterion-referenced tests allow teachers to determine which materials are appropriate for individual students or groups.

The program may be used in any type of facility or setting and does not rely on any particular methodology or teaching style, or require materials or equipment that are not normally found in schools. Seventy-five percent of the parents of the students in the evaluation study of this program observed their children implementing conservation practices at home that they had not seen before the children used the program materials.

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Marine Science Project: FOR SEA

Marine Science Center

By the year 2000, three out of four Americans will live within an hour's drive of the sea or Great Lakes coasts. The impact on these coastal waters will be severe. The nationally validated curriculum materials of this project are designed to equip students with information necessary to protect and maintain the world of water. Comprehensive, activity-oriented, marine education curricula are provided for use in addition to, or in lieu of, an existing science program. Curriculum guides for each of the grade levels (2, 4, 6, 7-8, and 9-12) contain teacher background for each activity, student activity and text pages, answer keys for student activities, a listing of vocabulary words for each unit, and a selected bibliography of children's literature and information books about the sea.

The project is designed to be implemented in classrooms at a room, grade, school, or district-wide level. Inservice training provides classroom teachers with an overview of the project, text implementation procedures, and activities designed to familiarize them with the materials. Hands-on materials generally are found in the school setting, or are readily available at local grocery or variety stores.

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GEMS by Satellite: An Innovative Model for Activity-Based Science

Inservice via Satellite

Educational Service District No. 101

Great Explorations in Math and Science (GEMS), developed at the Lawrence Hall of Science, is an exciting curriculum and inservice program that has been tested by hundreds of teachers nationwide. The GEMS curriculum was selected by the National Science Foundation for wide-scale national dissemination. This project, designed to improve K-8 science instruction, is using satellite technology to bring live, hands-on, interactive science inservice to 60 remote school districts (public and private rural schools) in Alaska, Idaho, Montana, Oregon, and Washington. It also involves administrators, parents, and community members, to provide a broad base of support. Satellite technology provides an economical way of reaching increasing numbers of school districts with satellite dishes.

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Computer Integration and Improvement of Science Education Program

Newark Board of Education

Through this project, elementary school teachers and computer teachers are participating in training programs to improve their skills in teaching science, to learn to use new technology, and then to integrate the use of this technology into the science curriculum. A project coordinator works with sixth and seventh grade teachers and computer teachers to plan and implement computer-based activities to improve science teaching, and to create models for dissemination to other schools and districts.

The project coordinator meets with the teachers, on a bimonthly basis, to identify appropriate software and other computer-based materials. During these sessions, the teachers develop lesson plans to use the computer-based materials in the teaching of science. Students participate in hands-on science activities, and begin to learn in a new way.

Collaborative arrangements have been established with business, colleges, and universities to provide training for elementary school teachers in this project.

Contact: Gail B. Savage
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Project AIMS: Academic Improvement in Middle Schools
Maine Center for Educational Services

The program is designed to affect the quality of instruction and academic achievement of students in five middle schools in Maine, and serve as a national model for other schools interested in integrating curriculum, instruction, and technology at the middle school level.

Project Academic Improvement in Middle Schools (AIMS) addresses the need to: (1) improve the ability of teachers to integrate computer technology into the middle school curriculum as a tool for instruction; and (2) develop integrated curriculum units to serve as models for integrating technology into the science, English, mathematics, and social studies curricula. Students are improving their knowledge, skills, and attitudes in each of these four highly important content areas, and in the use of computers and computer-driven technologies.

Teachers are developing expertise and abilities in using computers and computer-driven technologies; in holistic approaches to the curriculum; in three new instructional strategies; and in assessing student outcomes.

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SCRIPTT: Science Curriculum Readiness Instruction Per Televised Translations Program
School District of Philadelphia

This program uses technology to provide supplementary instruction in science, and reinforcement in English, for local educational agency public and private school students at the elementary and secondary levels, through videotaped programs in English, and in each of the following languages: Spanish, Vietnamese, Cambodian, Cantonese, Laotian, and Russian.

An outreach public awareness campaign for parents, designed to engage them in a cooperative partnership with teachers and schools, is an important part of the program. The students' abilities to understand science, and English as a foreign language, are enhanced by: using technology to strengthen instruction; giving parents the opportunity to participate actively in their children's education by viewing videotapes of their children's science lessons in their primary language; and segmenting bilingual science videotapes for active learning, to adjust learning speed to the individual student's needs.

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Parenting through Math, Science, and Beyond
Solana Beach School District

This project provides for comprehensive educational intervention with program components for students, teachers, and parents. Teachers learn the latest techniques in mathematics and science education, focusing on the use of mathematics manipulatives, hands-on science activities, and real-life applications of mathematics and science. Family workshops are conducted that focus on integration and application of mathematics and science skills, family-school collaboration, and parent-child cooperative learning. Families apply the skills learned at the family workshops with the help of easy-to-use at home activity packets.

During the year, several special events relating to mathematics and science are held for students, teachers, and families. Parents are involved in program planning, implementation, and evaluation. They take an active part in the planning and curriculum development stages. State and national guides are used in the development of the curriculum.

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U.S. Department of Education

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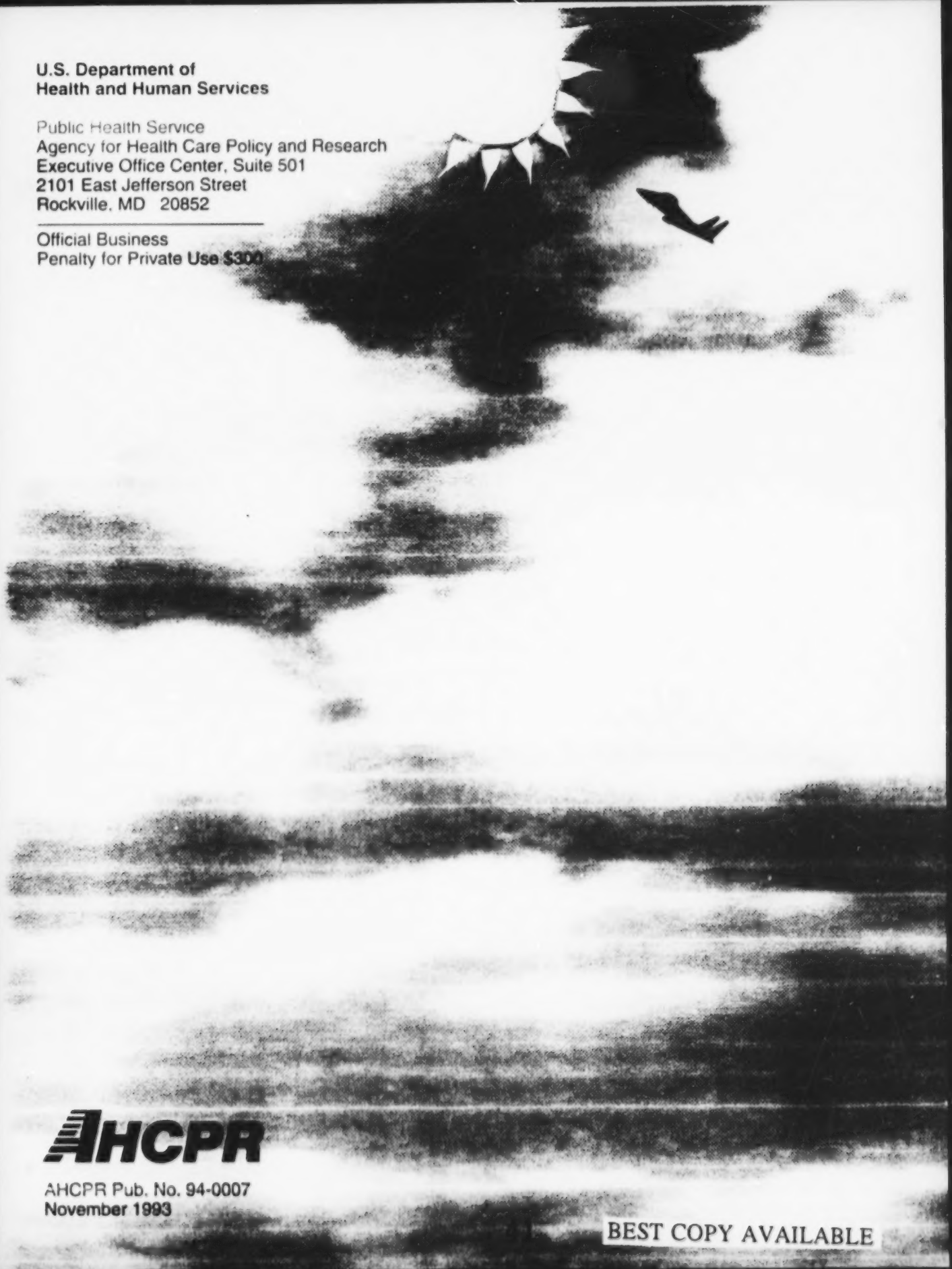

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